Int J Biol Med Res. 2012; 3(3): 2082-2084

BioMedSciDirect Publications

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International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original article

A comparative study of Left ventricular function in Athletes and Sedentary individuals

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ARTICLE INFO

Keywords:
Athletes
Echocardiography
Left ventricular function
Sedentary individuals

ABSTRACT

Aim:The aim of the present study is to describe echocardiographically determined functional changes in Athletes, which enhance the left ventricular function and to compare them with sedentary individuals. Materials and Methods: The study was conducted on male subjects (n=50), aged between 20 and 25 years, who are non smoking and non alcoholic. First the resting values are taken in both the groups and the parameters selected for the study are End Diastolic volume, End Systolic volume, Stroke volume and cardiac output. After making the initial recording through Echocardiography of the above parameters at rest, the subject is instructed to run for 15 minutes and the respective parameters are recorded as previously. Results and Discussion: In this study, when athletes were compared with sedentary lifestyle men, there was an increase in End Diastolic volume, Stroke volume and Cardiac output both at rest and during exercise, thus enhancing the left ventricular functional capacity in Athletes. Conclusion: Regular dynamic exercise induces significant physiological adaptations of cardiac functioning, which allows higher peak working capacity , making the Athletes more work efficient than the non-exercising sedentary individuals.

1.Introduction:

Earlier Cardiologists suggested rest for majority of their patients. But in recent years, exercise is prescribed as a non-pharmacological treatment for heart disease[1]. Exercise decreases the likelihood of smoking, reduces stress and has a short term reduction of appetite [2]. Exercise is a period of enhanced energy expenditure by skeletal muscles which is met by many complex adjustments of metabolism, respiration, circulation and temperature regulation[3].

Athletic training decreases the resting heart rate[4] by increasing the vagal tone. Training increases the cardiac stroke volume by increasing the preload and by decreasing the after load. Training induces some increase in myocardial contractility and cardiac hypertrophy[5] which contributes to the increase in cardiac stroke volume. An expansion of plasma volume is an early response to training contributing to increase in preload and therefore the stroke volume. Because of the lower resting heart rate and higher resting stroke volume, a trained Athlete can achieve much larger Cardiac output [6] during exercise than an untrained individual.

Echocardiography[7] is useful because it is inexpensive, non-invasive and repeatable and causes minimum discomfort to the subject. The purpose of this research is to prove that left ventricular functional capacity is superior in Athletes when compared to sedentary individuals and exercise induced changes in circulation improve the cardiac performance.

2.Materials and Methods

The study was conducted on male subjects (n=50), their age ranging from 20-25 years, who are non-smoking and non-alcoholic. The criteria for selection of sedentary individuals (n=25), is based on the fact that they have not been trained or exposed to any sort of Athletic activity prior to the present study. Even the individuals who are subjected to any type of regular recreational sports activity were deliberately excluded from this study. Thus, the sedentary individuals are individuals whose physical activity is minimal in their daily life. E.g., Shop keepers .The criteria for selection of Athletes(n=25) is based on the fact that they have been well trained

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or exposed to regular running from at least 3-4 years prior to the present study. Each subject was medically examined and their past medical history has been carefully evaluated solely aimed at excluding those with cardiac or pulmonary disease or hypertension or diabetes. Thus, unhealthy subjects were excluded and only the suitable subjects were accepted for this study. Prior to the study, each subject was informed in detail of its objectives and the aim of the research protocol and the methods to be used. Their consent was obtained.

2.1.Experimental protocol:

The volunteer is subjected to a preceding period of rest for one hour. The Blood pressure, both systolic and diastolic was recorded using the Sphygmomanometer and the Stethoscope. These recordings are made while the subject is made to lie flat on the table near the Echocardiograph. The echocardiograph used in this study is SIM 7000 CFM challenge of ESAOTE BIO Medica Company of Italy with a capacity of 220-240 volts and 50 Hz. In this particular study, the left ventricular functional capacity in sedentary individuals is compared with Athletes. First the resting values are taken in both the groups and the parameters selected for the study are End diastolic volume, End systolic volume, Stroke volume and Cardiac output. After making the initial recording of the above parameters at rest the subject is instructed to run for 15 minutes and then the respective parameters are recorded as previously.

3.Results

3.1.At rest:

The End diastolic volume has increased in Athletes by 39% (P Value < 0.001).The End systolic volume has increased by 60% in Athletes(P Value < 0.001). The Stroke volume has increased by 29% in Athletes (P Value < 0.001). Cardiac output has increased by 7% in Athletes when compared to sedentary men (P Value < 0.001).

3.2.After 15 minutes of Dynamic exercise:

The End diastolic volume after 15 Minutes exercise is greater in Athletes by 37% (P Value < 0.001).The End systolic volume is 37% more in Athletes (P Value < 0.001). The stroke volume after 15 minutes of exercise is 38% more than sedentary individuals (P Value < 0.001). The cardiac output is 34% more in Athletes (P Value < 0.001).

Table No.1 Mean left ventricular function values - at rest

Left ventricular function parameters	Sedentary individuals		Athletes		t value	*P value*
	Mean	SD#	Mean	SD		
End Diastolic Volume (ml)	97.44	1.12	163.44	1.12	158.82	<0.001
End Systolic Volume(ml)	33.20	0.76	53.44	0.76	11.03	<0.001
Stroke Volume (ml)	64.24	1.01	83.00	1.01	93.79	<0.001
Cardiac output (ml)	4645.7	109.5	5013.6	109.5	16.7	<0.001
Systolic Blood Pressure (mmHg)	122.08	2.41	112.00	2.41	-15.56	<0.001
Diastolic Blood Pressure (mmHg)	81.76	2.67	71.76	2.67	-14.93	<0.001

Table No. 2 . Mean left ventricular function values - after 15 minutes of dynamic exercise

Left ventricular function parameters	Sedentary individuals		Athletes		t value	*P value*
	Mean	SD#	Mean	SD		
End Diastolic Volume (ml)	103.44	1.12	142.44	1.19	119.12	<0.001
End Systolic Volume(ml)	32.28	0.74	44.44	0.51	67.98	<0.001
Stroke Volume (ml)	71.16	0.99	98.00	0.76	107.56	<0.001
Cardiac output (ml)	11561.4	166.2	15585.6	214.3	74.17	<0.001
Systolic Blood Pressure (mmHg)	161.92	2.04	152.00	2.16	-16.69	<0.001
Diastolic Blood Pressure (mmHg)	86.24	2.03	76.08	2.12	-17.32	<0.001

4.Discussion :

In our study, mean values of systolic BPs at rest are less by 9% and mean values of diastolic BPs are less by 13% in Athletes (Table No.1). After 15 minutes of dynamic exercises the systolic BPs are less by 6% and Diastolic BPS are less by12% in Athletes (Table No.2) [8]. Training induces an increased peripheral venous tone [9] .This increases the central blood volume and thus ventricular preloading [10]. An expansion of plasma volume is an early response to training, probably mediated by adjustments in the Renin - Aldosterone system [11]. Ventricular preloading is increased, contributing to the increase of cardiac stroke volume[12] in the athletes. In the heart, End-diastolic volume[13] forms the preload and stretching of the cardiac muscle fibres to increase their initial length depends on the End diastolic volume. In our study we found that, the End-Diastolic volume in Athletes at rest is found to be 136.44ml and in sedentary it is 97.44ml (Table No.1). After 15 minutes of exercise the End-Diastolic volume is 142.44ml in athletes and 103.44ml in sedentary individuals. The increase of stroke volume leads to a roughly proportional increase in functional capacity [14]. A given physical task can thus be performed at a smaller fraction of the individual's maximal oxygen intake. In our study, stroke volume at rest has significantly high in Athletes by 29% and cardiac output [15] at rest is high by7% in Athletes (Table No.1).

5.Conclusion

Regular dynamic exercise induces significant physiological adaptations of cardiac functioning, which allows higher peak working capacity, making the exercising individuals more work efficient than the non-exercising sedentary lifestyle individuals. In this study, when Athletes were compared with sedentary life style men, there was an increase in End diastolic volume, stroke volume and cardiac output at rest and during exercise, thus enhancing the left ventricular functional capacity in Athletes.

Acknowledgments:

The authors would like to thank our Physical Director for his role in this study. The authors are also thankful to the Management, Katuri Medical College &Hospital, Guntur, for their support throughout the study.

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